

DESCRIPTION

APPARATUS FOR UPGRADING OF A ONE-WAY MESSAGE TRANSMISSION SYSTEM

6 Technical Field

The present invention relates to a message transmission system and particularly, but not exclusively, to a 2-way paging system.

Background Art

10 Answer back paging systems are known for example from PCT Patent Specification WO 96/14716. In an elementary form such a system requires a paging network controller(PNC) to arrange for a message to be transmitted to a predetermined addressee. The addressee on receiving a call is able to transmit a simple reply by way of a low power transmitter incorporated into the
15 pager.

Many operators of what is termed one-way paging systems operating in accordance with an approved protocol, such as POCSAG(alternatively known as the CCIR Radiopaging Code No. 1) or ERMES (an European Telecommunications Standards Institute (ETSI) approved standard) wish to
20 upgrade their systems to become 2-way paging systems. However such operators are reluctant to have to dispose of their currently installed and proven equipment and to replace it with unproven new equipment which is not only costly but also involves a great deal of upheaval.

25 Disclosure of Invention

An object of the present invention is to provide a 2-way message transmission system at minimal cost and inconvenience.

According to one aspect of the present invention there is provided an answer-back messaging apparatus for use with a one way message
30 transmission system in which a plurality of messages are transmitted by a primary station on a down-link to a plurality of secondary stations, each

secondary station having means for transmitting on an up-link a response to a message addressed to the secondary station, the answer-back messaging apparatus comprising means for monitoring the messages on the down-link, means for recovering the or each response transmitted on the up-link and
5 means for matching the or each response with a respective message transmitted on the down-link.

The means for means for monitoring the messages on the down-link may comprise a radio receiver tuned to the frequency of the down-link. By using a separate radio receiver it is unnecessary to make a direct electrical connection
10 to the one way message transmission system thereby leaving the latter system unmodified.

The apparatus may further comprise means for relaying a response, which has been matched to an outgoing message, or an up-link message to an intended recipient. The means may comprise electronic mail transmission
15 means or means for forwarding the recovered response or a message to the one way message transmission system whereby the response or a message is sent as a one-way paging signal. Alternatively the responses or messages may be stored for subsequent retrieval by the intended recipient in a similar manner to telephone answering service.

Storage means may be provided for storing the identification of a down-link message and of the originating party of the said down-link message, and means may be provided which are responsive to the forwarding of a response, or the lack of response, to a message to a recipient for erasing the said
20 identifications from said storage means. By erasing identifications in this manner the size of the storage may be kept to a minimum.

According to another aspect of the present invention there is provided an answer-back messaging apparatus for connection to a one-way paging system having a primary station for transmitting signals on a down-link, the apparatus comprising means for causing said primary station to initiate the
30 transmission of a control message to a two-way pager, the two-way pager having means for deriving from the control message an indication of when it

can initiate transmission of an up-link message, the apparatus further including means for receiving and decoding the up-link message, means for causing the primary station to transmit an acknowledgement message to the two-way pager, and means for forwarding the up-link message to an intended recipient.

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Brief Description of Drawings

The present invention will now be described, by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a block schematic diagram of the answer-back messaging apparatus made in accordance with the present invention (enclosed in broken lines) being used in combination with a one-way paging system,

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Figure 2 is a block schematic diagram of an answer-back messaging apparatus having a single down-link and up-link receiver,

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Figure 3 is a block schematic diagram of a secondary station constituted by an answer-back pager,

Figures 4A and 4B illustrate how acknowledgements are combined with an invitation signal transmitted on the down-link,

Figure 5 is a diagram showing the transmission of invitation signals, reception of CDMA responses and the analyses of the responses, and

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Figure 6 is a diagram showing the interlaced operation of a CDMA response type of system.

In the drawings the same reference numerals have been used to indicate corresponding features.

25 Modes for Carrying out the Invention

Referring to Figure 1, for ease of description the one-way message transmission will be described first.

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The one-way message transmission system comprises a paging network controller (PNC) 10 having a message entry port 12 which receives pager numbers and associated messages from an operator equipped with a personal computer (PC) or directly from a subscriber having a PC and a modem. The

PNC 10, which comprises directories containing information such as pager radio identity codes (RICs), areas to be paged, frequencies, pager types, prevailing protocols, for example POCSAG (or CCIR Radiopaging Code No 1) and ERMES, and status of the pagers, assembles the messages and their associated RICs together with other relevant information into data packets which are forwarded to a paging area controller (PAC) 14. The PAC 14 arranges the data into code words and adds error detecting check bits to the code words which are assembled into batches, each of which is headed by a synchronisation code word. The concatenated batches of data messages are relayed to base station transmitters BS1, BS2 and BS3 operating in a quasi-synchronous mode on a down link frequency. A receive-only or one way pager 16 which is programmed to operate in accordance with a predetermined protocol is powered-up in accordance with a battery economising protocol to detect the sync code word and for its pre-arranged frame in order to be able to detect any messages addressed to it. In the case of a message for the pager exceeding the duration of its frame, it remains energised.

Referring to the answer-back messaging apparatus shown in the broken line box. A two-way pager 18, capable of transmitting short responses to messages, also is able to receive messages on the down-link frequency from one or more of the base stations BS1, BS2 and BS3 depending on its particular geographical location relative to the base stations and topographical features in the respective signal paths.

If a two-way pager 18 identifies that a message is being transmitted having its RIC, it receives the message and decodes it. If the user wishes to send a brief response then, by means of an integral key pad, the user selects a pre-stored response and when invited by a control message from the PAC 16 it transmits its response by way of an up-link having a different frequency from the down-link. The response signals from a plurality of two-way pagers may be sent simultaneously as CDMA signals or in a frame of time slots, one time slot being usable by a response.

At least two up-link receivers (Rx_u) 20A and 20B receive the response

signals and in order to be able to determine to which message each response is replying to at least two down-link receivers (Rx_d) 22A and 22B are provided to receive the batches of address and message code words transmitted by one of the base stations BS1, BS2 and BS3. The outputs from the receivers 20A, 20B, 22A, 22B are relayed by a land-line link to an Answer-back Area Controller (AAC) 24 which amalgamates corresponding messages and/or responses received by Rx_d 20A and 20B and Rx_d 22A and 22B. An output from the AAC 24 is relayed to an Answer-back Network Controller (ANC) 26. In the ANC 26 the responses are analysed and the messages and responses are matched. Also, optionally, in the ANC 26 the responses are analysed and by means of labels in the down-link messages, the messages and responses are matched to the caller's identity, such as the caller's pager number or e-mail address.

The responses are relayed and/or made available to their intended recipients in a number of ways. The ANC 26 is coupled by way of an interface 28 to the PNC 10. This interface enables the ANC 26 to route a response together with the intended recipient's pager number to the PNC 10 which enables the response to be relayed by way of the one-way paging system. Optionally, by way of an input/output port 30, the ANC forwards the response by electronic mail to its intended recipient or arranges the response to be stored pending subsequent retrieval by the intended recipient contacting the store, for example in the manner of a message answering service. Optionally non-response signals, such as requests for service, can be transmitted on the up-link and be made available to intended recipients in the same way as response signals.

In the case of wanting to send a message requiring a response from a two-way pager 18, then an originator of the message sends the pager number and the message to the ANC 26 by way of the input/output port 30. The ANC 26 adds a control field, for example a label, to the pager number and message which is forwarded to the PNC 10 which treats the received data in the same way as a one-way paging message and by means of its appended directories

determines the RIC to be appended to the message and other information as indicated above. A stream of messages is forwarded to the PAC 14 for arrangement in to a batch structure in readiness for transmission by the base stations BS1, BS2 and BS3.

5 The apparatus shown in Figure 2 comprises a buffer store 32 for holding pager numbers and associated messages which are received by the input/output port 30. A microcontroller 34 appends a control field, which comprises a label used for identifying the message, to the pager number/message and forwards it to the PNC 10 by way of the interface 28.
10 The microcontroller 34 is operated in accordance with a program stored in a program store 35.

 The down-link messages received by the Rx_d 22 are applied to an input of a matching stage 36. The CDMA up-link messages received by the Rx_u 20 are applied to a signal analysis stage 38 in which each message is multiplied
15 by the codes held in a code store 40 until the message is decoded or de-spread. As each response is recovered it is applied to another input of the matching stage 36 where it is matched with the respective down-link message. One technique for matching will be described later.

 The response together with at least the label which had been appended
20 by the microcontroller 34 are forwarded to the microcontroller in which the label is compared with the labels given to messages forwarded earlier to the PNC 10 and when a match is found then the associated pager number is identified. The microcontroller 34 is then, in accordance with pre-stored instructions, able to deliver the message in accordance with the intended recipient's instructions,
25 as outlined above.

 Referring to Figure 3, a two-way pager comprises a receiver 42 connected to a decoder 44 which in turn is coupled to a control processor 46. The processor 46 operates in accordance with a program stored in a read-only memory 48. The processor also includes an address store (not shown) which
30 contains the unique addresses of that pager. In the event of the pager receiving a message then this is stored in a random access memory 50. The

messages can be displayed subsequently on a LCD panel 54 which has its associated driver 52 coupled to the control processor 46. Annunciating devices which may comprise an acoustic transducer 56, a light emitting transducer 58 and a vibrator 60 are coupled to the control processor 46. A keypad 62
5 provides a man machine interface whereby a user can instruct the processor to carry out various functions, for example to display a stored message on the panel 54. A transmitter 64 is coupled to an output of the processor 46 and to an antenna 66. A receiver power control stage 68 is coupled between the processor 46 and the receiver 42 in order to practice battery conservation in
10 accordance with the provisions of the paging protocol being followed. In the event of the pager sending response signals as spread spectrum signals then the control processor 46 stores a number of pseudo random codes, each one being representative of a particular reply which is selected by the user actuating the keypad 62. The selected code is then relayed to the transmitter
15 64 for onward transmission. If as an option power control is to be applied to the transmitter 64 then a power control signal is supplied by the processor 46 through a control line 70.

One method of operating an answer-back system in which responses are transmitted as CDMA signals will be described with reference to Figures 4A
20 and 4B. Initially the base stations BS1, BS2 and BS3 transmit an ordered sequence of concatenated messages M1 to M14 in batches, each batch commencing with a synchronisation code word S. Although not shown each of the messages M1 to M14 includes the address of the pager to which the message is being directed. Once the transmission is complete an invitation is
25 given by the PNC 10 to the two-way pagers 18 to transmit their responses. Once the responses have been received and analysed, there is high likelihood that not all the messages will be responded to because of what is term the near/far effect of relatively strong CDMA signals masking relatively weak CDMA signals. Accordingly the PNC 10 acknowledges those responses which have
30 been successfully matched and issues another invitation to those pagers 18 which have not had their responses acknowledged to send/re-send them. One

method of issuing an invitation message whilst simultaneously informing those pagers whose responses have been analysed successfully is shown in Figure 4B. The invitation signal INV2 has a field FD with a corresponding number of elements as there are messages which are allocated on a 1 to 1 basis, thus
5 element 3 corresponds to message M3. When a first invitation signal INV1 is transmitted, say all the bits in the field FD are zero indicating that no responses have been received. However, after the first round of analyses, acknowledgements are transmitted to the pagers to which say the messages M1, M3, M4, M9, M11 and M13 were addressed by changing the bits in
10 elements 1, 3, 4, 9, 11 and 13 of the field FD from "0" to "1". Further bits are changed as more of the messages are acknowledged.

The number of cycles in which invitations are transmitted may be fixed. However, if it is determined that the number of successfully decoded responses exceeds a statistically determined threshold value, then further iterations are
15 stopped.

Figure 5 illustrates an example of a sequence of operations following the transmission of a sequence of messages. As with Figures 4A and 4B, the responses comprise simultaneously transmitted CDMA signals. A first invitation INV1 is transmitted on the down-link. The pagers which have detected a
20 message addressed to them respond to the invitation signal INV1 by transmitting a code sequence within a defined time slot RES1. A search routine SCH is initiated following expiry of the time slot. In the search routine, de-spreading codes stored in the ANC code store 40 (Figure 2) are successively compared with the response code sequences and one by one the
25 responses to particular ones of the messages are identified. However, as explained above only the relatively strong response signals are detected and these are eliminated from the next search. The invitation, response and search cycle is repeated several times, each cycle commencing with an invitation signal INV2, INV3 and so on.

30 It is anticipated that in a practical system the majority of the two-way pagers 18 (Figure 1) will be some distance from the antenna of the receiver(s)

20 which means that they will have a low power at the antenna. Accordingly, although the durations of the time slots RES1, RES2 and RES3 may be equal, as shown, it is preferable that variable slot lengths be allocated according to the anticipated number of responses, for example a low number of relatively
5 high powered responses and a high number of relatively low powered responses. Short slots are allocated initially so that the few, strong powers contending against low noise and interference can be eliminated efficiently. Longer slots are then allocated to accommodate the weak received powers contending against significant levels of noise and interference.

10 If desired the two-way pagers 18 may have power control on their transmitters in order to vary the strength of their response signals and in so doing reduce the number of invitation/response cycles.

In a refinement of the embodiment described with reference to Figure 5, Figure 6 shows dividing the population of the pagers into two groups and
15 interleaving the transmission of messages and invitations for one group Gp1 on the down-link with analysing the responses on the up-link from the other group Gp2.

One method of dividing the pager population is to assign the odd numbered pagers to one group, say Gp1, and the even numbered pagers to a
20 second group, say Gp2. An alternative method is for the two-way pager 18 to measure the strength (RSSI) of the received down-link signal and by using a pre-set threshold determine to which one of say two groups it belongs.

Although the present invention has been described with reference to a digital paging system the present invention may be used in a cellular or
25 cordless telephone system having provision for two-way paging.

From reading the present disclosure, other modifications will be apparent to persons skilled in the art. Such modifications may involve other features which are already known in the design, manufacture and use of message transmission systems or component parts thereof and which may be used
30 instead of or in addition to features already described herein. Although claims have been formulated in this application to particular combinations of features,

it should be understood that the scope of the disclosure of the present application also includes any novel feature or any novel combination of features disclosed herein either explicitly or implicitly or any generalisation thereof, whether or not it relates to the same invention as presently claimed in any claim and whether or not it mitigates any or all of the same technical problems as does the present invention. The applicants hereby give notice that new claims may be formulated to such features and/or combinations of such features during the prosecution of the present application or of any further application derived therefrom.

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Industrial Applicability

The present invention is applicable to upgrading a 1-way communications systems to a 2-way system without having to make any major changes to the already installed equipment.

CLAIMS

1. An answer-back messaging apparatus for use with a one way message transmission system in which a plurality of messages are transmitted by a primary station on a down-link to a plurality of secondary stations, each secondary station having means for transmitting on an up-link a response to a message addressed to the secondary station, the answer-back messaging apparatus comprising means for monitoring the messages on the down-link, means for recovering the or each response transmitted on the up-link and means for matching the or each response with a respective message transmitted on the down-link.

2. An apparatus as claimed in claim 1, characterised by means for relaying a response which has been matched to a recipient.

3. An apparatus as claimed in claim 2, characterised in that said means for relaying a response comprises electronic mail transmission means.

4. An apparatus as claimed in claim 2, characterised in that said means for relaying a response comprises means for forwarding the recovered response to the one way message transmission system whereby the response is sent as a one-way paging signal.

5. An apparatus as claimed in claim 1, characterised in that storage means are provided for storing the identification of a down-link message and of the originating party of the said down-link message, and in that means are provided which are responsive to the forwarding of a response, or the lack of response, to a message to a recipient for erasing the said identifications from said storage means.

6. An apparatus as claimed in claims 1, characterised in that said



means for matching the response signals to the transmitted messages generates an acknowledgement signal which is forwarded to the primary station for transmission on the down-link, and in that in response to matching all the intelligible responses, said means for matching has means for generating at least one invitation message which is relayed to the primary station for transmission on the down-link inviting those secondary stations which have not received an acknowledgement to send/resend their responses on the up-link.

7. An answer-back messaging apparatus for connection to a one-way paging system having a primary station for transmitting signals on a down-link, the apparatus comprising means for causing said primary station to initiate the transmission of a control message to a two-way pager, the two-way pager having means for deriving from the control message an indication of when it can initiate transmission of an up-link message, the apparatus further including means for receiving and decoding the up-link message, means for causing the primary station to transmit an acknowledgement message to the two-way pager, and means for forwarding the up-link message to an intended recipient.

8. An apparatus as claimed in claim 7, wherein the up-link messages are transmitted as CDMA signals, and in that said receiving and decoding means comprises means for conducting a code search on the received up-link signals to de-spread them.

9. An apparatus as claimed in claim 7, wherein the primary station transmits messages on the down-link, and wherein said control message invites two-way pagers to transmit responses to said messages on the up-link, characterised in that means are provided for matching the responses to the messages, each of said responses being acknowledged by the primary station and in that said matching means causes the primary station to transmit another control message inviting those two-way pagers which have not received an acknowledgement to send/resend their responses.

